of multiple contiguous channels. While the discussion herein is primarily directed to satellite communication systems, one of ordinary skill in the art will appreciate that the disclosed techniques are applicable to other communication systems (e.g., terrestrial-based cellular systems) that integrate wideband services with narrowband services.

As utilized herein, the term "satellite" includes a man-made object or vehicle for orbiting a celestial body, such as the Earth, and encompasses both geostationary and orbiting satellites. As used herein, the term "constellation" includes a group of satellites arranged in orbits for providing coverage (e.g., radio communication) over a portion or all of a celestial body and may include geostationary satellites, orbiting satellites (i.e., low-Earth orbiting (LEO) satellites and medium Earth orbiting satellites) or combinations of such satellites. A constellation typically includes multiple rings (or planes) of satellites and may have equal numbers of satellites in each plane. The term "cell" and "antenna pattern" are not intended to be limited to any particular mode of generation and includes those created by either terrestrial or satellite cellular communication systems and/or combinations thereof.

FIG. **1** illustrates a simplified diagram of a communication system **10** that includes a plurality of orbiting satellites **12** occupying a plurality of polar orbits **14**. The present invention is also applicable to satellite communication systems that have non-polar orbits (e.g., equatorial). While only nine satellites **12** and six polar orbits **14** are shown in FIG. **1**, one of ordinary skill in the art will appreciate that any number of satellites or orbits may be utilized to provide a desired coverage.

When satellites **12** are LEO satellites, a line-of-sight electromagnetic (e.g., radio and light) communication of any one satellite **12** covers a relatively small area of the Earth, at any instant. A typical LEO satellite **12** travels at approximately twenty-five thousand kms/hr with respect to the Earth. As such, each satellite **12** is visible to a terrestrial station, such as individual subscriber unit (ISU) **26**, for a period of approximately nine minutes, according to the system shown.

Each satellite **12** communicates with terrestrial stations, which may include some number of ISUs **26** and Earth terminals (ETs) **24** connected to a system control segment (SCS) **28** or a gateway (GW) **22**. Each GW **22** may provide access to a public switched telephone network (PSTN) (not shown in FIG. **1**) or other communication facility. ETs **24** may be adjacent to or separate from SCSs **28** and/or GWs **22**. ETs **24** that are associated with SCSs **28** receive data describing tracking of satellites **12** and relay packets of control information. ETs **24** associated with GW **22** typically only relay data packets (e.g., relating to calls in progress).

ISUs **26** may be located anywhere on the surface of the Earth or in the atmosphere above the Earth, such as aboard an airplane. ISUs **26** are preferably communication devices capable of transmitting data to and receiving data from satellites **12**. By way of example, ISU **26** may be a hand-held portable cellular telephone adapted to communicate with satellites **12**. Normally, ISU **26** does not perform any control functions for communication system **10**.

Communication system **10** may accommodate a large number of ISUs **26**, which typically communicate with nearby satellites **12** via subscriber links **16**. Links **16** encompass a limited portion of the electromagnetic spectrum that is divided into numerous channels. For example, links **16** may be combinations of L-band frequency channels and may encompass various air interface standards (e.g., Frequency Division Multiple Access (FDMA), Time Division Multiple Access (TDMA), Code Division Multiple Access (CDMA)) or a combination of such air interface standards. At a minimum, satellite **12** regularly transmits over one or more broadcast channels **18**. ISUs **26** synchronize to broadcast channels **18** and monitor broadcast channels **18** to detect messages which are addressed to them. ISUs **26** transmit messages to satellites **12** over one or more acquisition channels **19**. Broadcast channels **18** and acquisition channels **19** are typically not dedicated to any one ISU **26**, but are shared by all ISUs **26** currently within the footprint of a given satellite **12**.

Traffic channels **17** are typically two-way real-time channels that are assigned to a particular ISU **26**, by a given satellite **12**, from time-to-time. Preferably, a digital format is used to communicate data over channels **17–19**. At least one traffic channel **17** is assigned for each call, and each traffic channel **17** has sufficient bandwidth to support, at a minimum, a two-way voice conversation. To support real-time communications, a TDMA scheme may be used to divide time into frames (e.g., ten to ninety milliseconds). In such a scheme, each ISU **26** is assigned a specific traffic channel **17** and specific transmit and receive time-slots within each frame of the specific traffic channel **17**. Analog audio signals are preferably digitized such that during each frame, the digitized audio signal is transmitted or received in a single short high-speed burst during an allotted time-slot. Each satellite **12** may support up to a thousand or more traffic channels **17** such that each satellite **12** can simultaneously service a number of independent calls. Those of ordinary skill in the art will appreciate that traffic channels **17** can be formed without a time-slot structure and that methods that do not require digitizing an analog signal (e.g., voice) may be employed. Various known techniques may be employed to form the channels and process the voice communication.

Satellites **12** communicate with other nearby satellites **12** through cross-links **23**. Thus, a call or communication from an ISU **26** located at any point on or near the surface of the Earth may be routed through the constellation of satellites **12** to within range of substantially any other point on the surface of the Earth. A communication may be routed down to an ISU **26** on or near the surface of the Earth from a satellite **12** using subscriber link **16**. Alternatively, a communication may be routed down to or up from ETs **24**, of which FIG. **1** shows only two, through Earth links **15**. ETs **24** are usually distributed over the surface of the Earth in accordance with geographical/political boundaries. Each satellite **12** is preferably capable of communicating with multiple ETs **24** and ISUs **26** at any given instant.

SCS **28** monitors the health and status of system communication nodes (e.g., GWs **22**, ETs **24** and satellites **12**) and normally manages operations of communication system **10**. One or more ETs **24** provide the primary communications interface between SCS **28** and satellites **12**. ETs **24** typically include antennas and RF transceivers for performing telemetry, tracking and control functions for the constellation of satellites **12**.

GWs **22** may perform call processing functions in conjunction with satellites **12** or GWs **22** may exclusively handle call processing and allocation of call handling capacity within communication system **10**. Various terrestrial-based communication systems, such as, the PSTN (not shown), may access communication system **10** through GWs **22**.

When the Earth is fully covered by satellites **12**, any satellite **12** may be in direct or indirect data communication